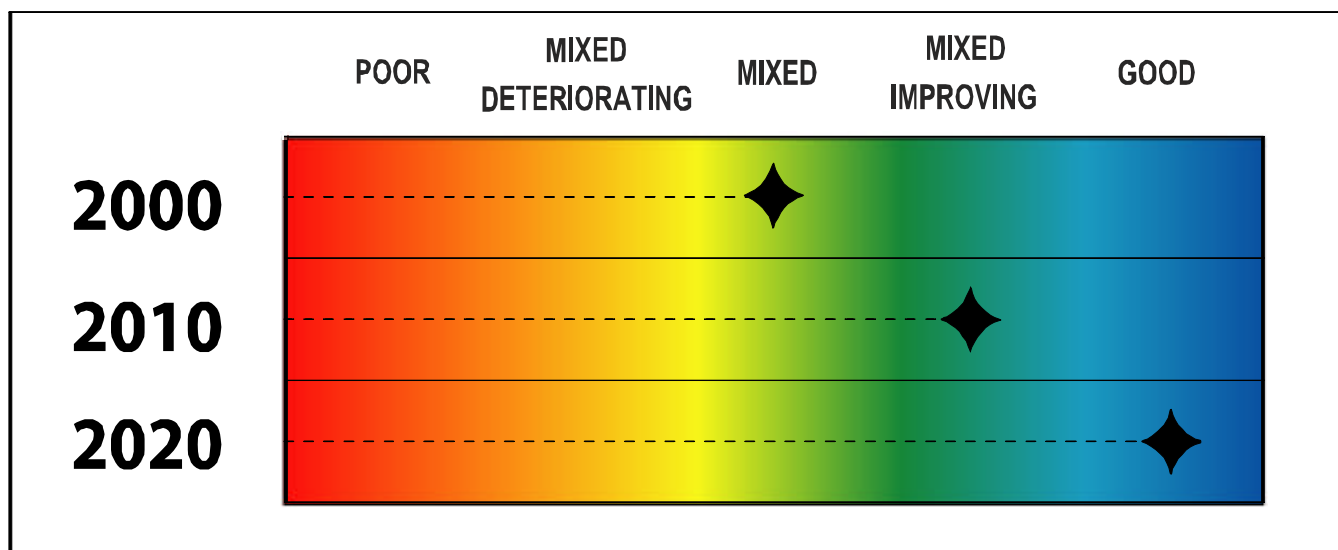


Subgoal 7

Are sediments, air, land, and water sources or pathways of contamination that affect the integrity of the ecosystem?



Status

Sediments, air, land, and water continue to be sources or pathways of contamination that affect the integrity of the Lake Michigan ecosystem. While regulatory and remediation programs reduce pollutant sources, ongoing releases and the region's legacy of contamination continue to serve as sources of pollutants. As a result, the status of this goal is mixed. There has been significant activity that will assist in changing the status to mixed/improving over the next decade. In particular, the findings of the Lake Michigan Mass Balance Study will allow decision-makers to better understand pollution pathways and adopt policies to address pollutant sources.

A major event during the last two years was the passage of the Great Lakes Legacy Act which provides \$45 million over three years to clean the legacy of contamination in the Areas of Concern, mostly involving mercury and PCBs. In addition, while annual monitoring of the lake by the U.S. EPA Great Lakes National Program shows no nutrient problems in the open waters of the lake,

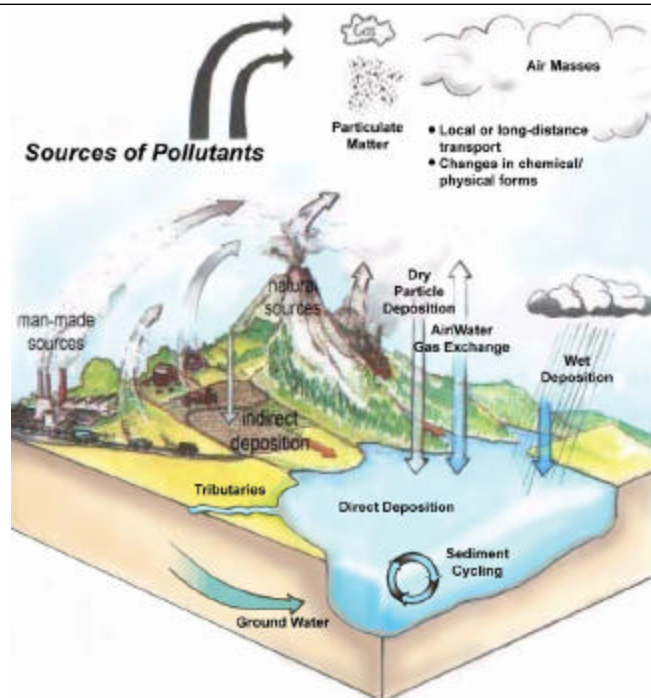


Figure 7-1 Pollutants enter Lake Michigan through several pathways

Source: <http://www.epa.gov/owow/oceans/airdep>
Augmented by Joseph F. Abboreno

Cladophora blooms have been reported in nearshore areas and embayments and the need exists to investigate the cause.

The following section presents recent findings regarding pollution pathways and predictions of future levels of PCBs in lake trout fish tissue and atrazine in the waters of Lake Michigan. The section concludes with an overview of specific pathways that continue to serve as sources of pollutant load to Lake Michigan.

Challenges

- To gather data on sources and pathways of contaminants in Lake Michigan.
- To develop a better understanding of the natural dynamics that affect pollutant distribution in the Lake Michigan ecosystem.
- To reduce pollutant loads with effective control and pollution control measures
- To develop coordinated monitoring in 2004 or 2005 and to develop a 10-year trend analysis based on the 1994 mass balance project for the lake.

Lake Michigan Mass Balance Project

The Lake Michigan Mass Balance (LMMB) Project is an enhanced monitoring and modeling project that is working to develop a scientific base of information to inform LaMP policy decisions and better understand the science of pollutants within an ecosystem. The LMMB Project's specific objectives are:

- To identify relative loading rates of four categories of pollutants (PCBs, mercury, pesticides, transnonachlor, and atrazine) entering Lake Michigan from major media (air, tributaries, and sediments);
- To establish baseline loading estimates in 1994-95 against which to gauge future progress
- To develop the predictive ability through the use of models to determine the environmental benefits of specific load reduction scenarios for toxic substances and the time required to realize those benefits;
- To improve our understanding of key

environmental processes governing the movement of pollutants through and out of the lake (cycling) and fish and plant life (bioavailability) within relatively closed ecosystems.

The LMMB Project focused on constructing mass balance models for a limited group of pollutants. Polychlorinated biphenyls (PCBs), trans-nonachlor, atrazine, and mercury were selected for inclusion in the LMMB Project because these pollutants currently or potentially pose a risk to aquatic and terrestrial organisms (including humans) in the Lake Michigan ecosystem. These pollutants were also selected to cover a wide range of chemical and physical properties and represent other classes of compounds which pose current or potential problems. Once a mass budget for selected pollutants is established and a mass balance model calibrated, additional contaminants can be modeled with limited data.

In the Lake Michigan system, pollutant inputs may

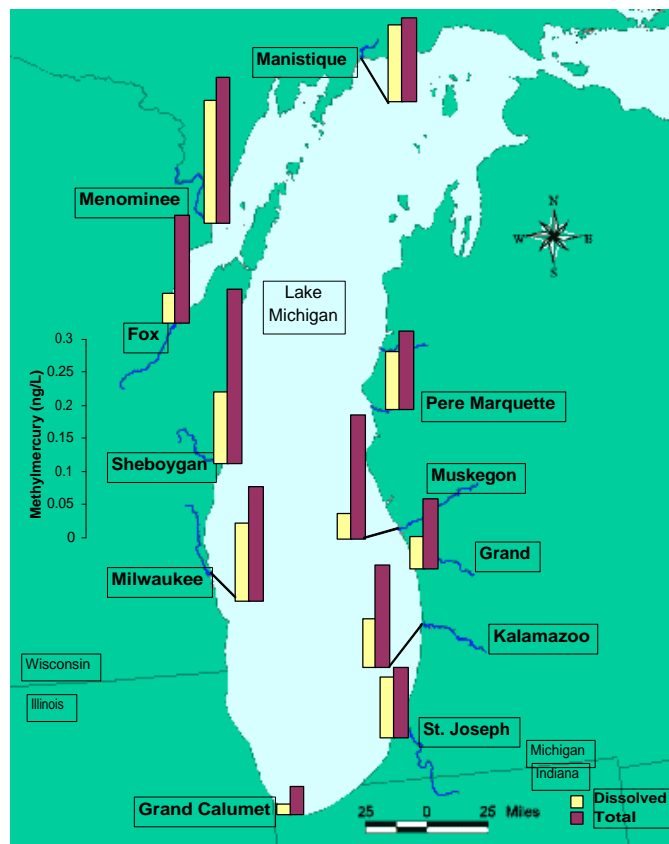
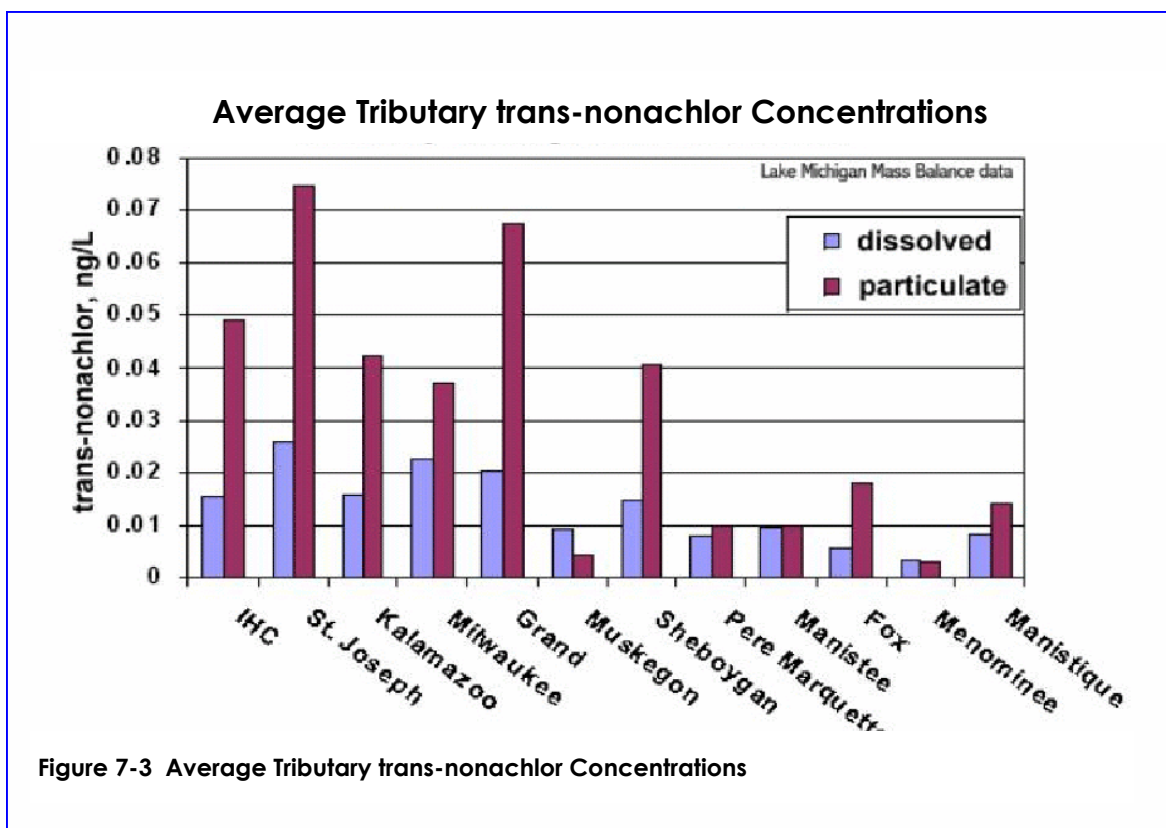


Figure 7-2 Lake Michigan Mass Balance Findings: Methylmercury in Lake Michigan Tributaries



come from atmospheric deposition, tributary loads, or sediments. Pollutants may leave the system through volatilization to the atmosphere, or discharge through the Straits of Mackinac. Pollutants within the system may be transformed through degradation or stored in ecosystem compartments such as the sediments, water column, or biota, including humans.

Pollutants and Pathways to Lake Michigan

While the LMMB study focused on four pollutants to develop a better understanding of pollutant fate and transport within the Lake Michigan ecosystem, many other pollutants are entering the ecosystem through a variety of pathways. The following discussion addresses recent investigations of four of these pathways:

- Atmospheric deposition,
- Nonpoint source runoff, including combined sewer overflows (CSO)
- Sediment
- Groundwater

Atmospheric Deposition

The role of air pollution as an important contributor to water pollution has long been recognized and has been the subject of growing scientific study and concern in recent years. Over the past three decades, scientists have collected a large and convincing body of evidence showing that toxic chemicals released into the air can travel great distances before they are deposited on land or water. Most notably, PCBs and some persistent pollutants (including several pesticides that have not been used in significant amounts in the United States since the 1970s) have been widely distributed in the environment and are now part of the global atmospheric background. Section 112 of the Clean Air Act required congressional reports of the effect of air deposition on the "Great Waters" of the United States, including the Great Lakes.

Loadings of pesticides whose use has been canceled or restricted in the United States to Lake Michigan are primarily from atmospheric sources that may be impossible to regulate or control.

PCB Loads (kg/year) to Lake Michigan from Major Monitored Tributaries, 1994-1995

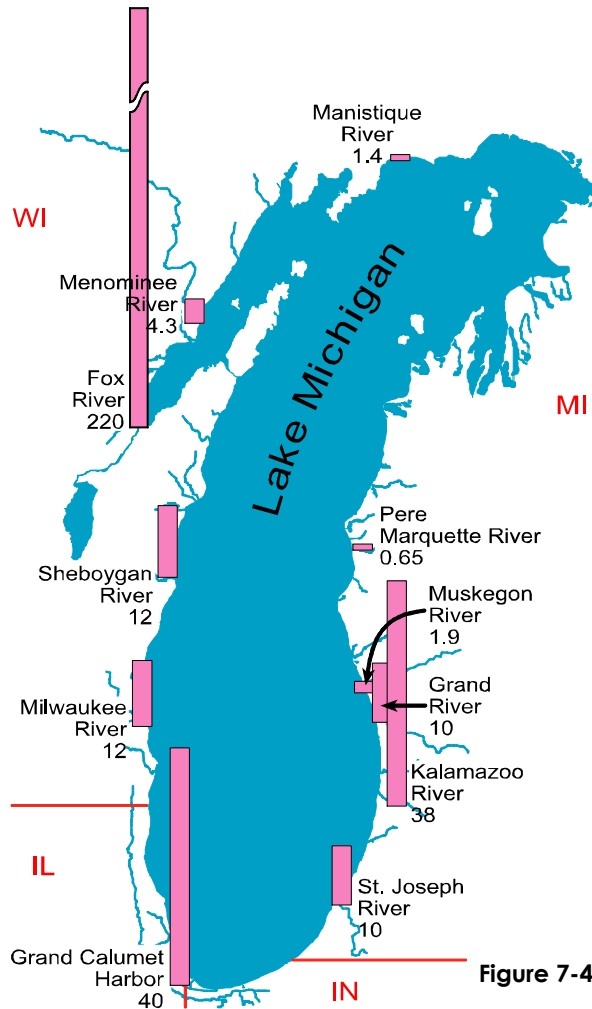


Figure 7-4

Although there are no current commercial sources of banned pesticides in the United States, loadings continue from use of remaining consumer stocks, evaporation from soils, resuspension of contaminated sediments, and atmospheric transport from other countries that continue to apply these substances. Further pesticide reductions can only be achieved through cleanup of contaminated sites, collection and disposal of existing stockpiles ("clean sweeps"), and use reduction in other countries.

Between 1988 and 2001, EPA Region 5 estimates that agricultural clean sweeps have removed 1.9 million pounds of pesticides from the Great Lakes basin (Figure 7-5)

While long-range atmospheric transport is an

important pollutant source for Lake Michigan, recent studies also point to the influences of local sources, particularly from urban areas. For example, air sampling over Lake Michigan when the wind is blowing from the southwest shows contributions of PCBs, PAHs, and mercury from the Chicago area to the lake. The relative importance of each pollutant source to the overall loadings is variable depending on the season and local weather conditions.

Nonpoint Source Pollution

According to the U.S. EPA National Water Quality Inventory Reports to Congress, states, tribes, and other jurisdictions consider siltation and the over enrichment of nutrients two of the three most significant causes of impairment in many of the streams throughout the Nation. Siltation alters aquatic habitat and suffocates fish eggs and affects other bottom dwelling organisms. Excessive nutrients have not only been linked to hypoxia in the Gulf of Mexico, but also to eutrophication and *Cladophora* blooms in many of the bays and beaches around Lake Michigan. Research in the 1960's and 70's linked *Cladophora* blooms to high phosphorus levels in the water, mainly as a result of agricultural runoff, detergents containing phosphorus, inadequate sewage treatment, and other human activities such as fertilizing lawns and poorly maintained septic systems (More information is available at www.uwm.edu/Dept/GLWI/cladophora). Due to tighter restrictions, phosphorus levels declined during the 1970's and *Cladophora* blooms were largely absent in the 1980's and 90's. Recently

Region 5 Agricultural Clean Sweep Results 1988-2001

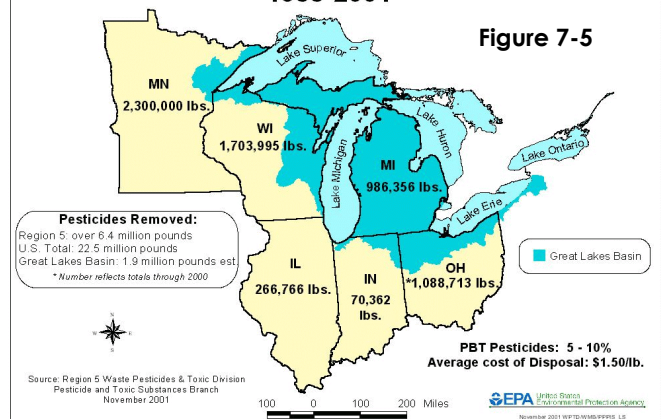


Figure 7-5

Atrazine Loadings from Tributaries to Lake Michigan

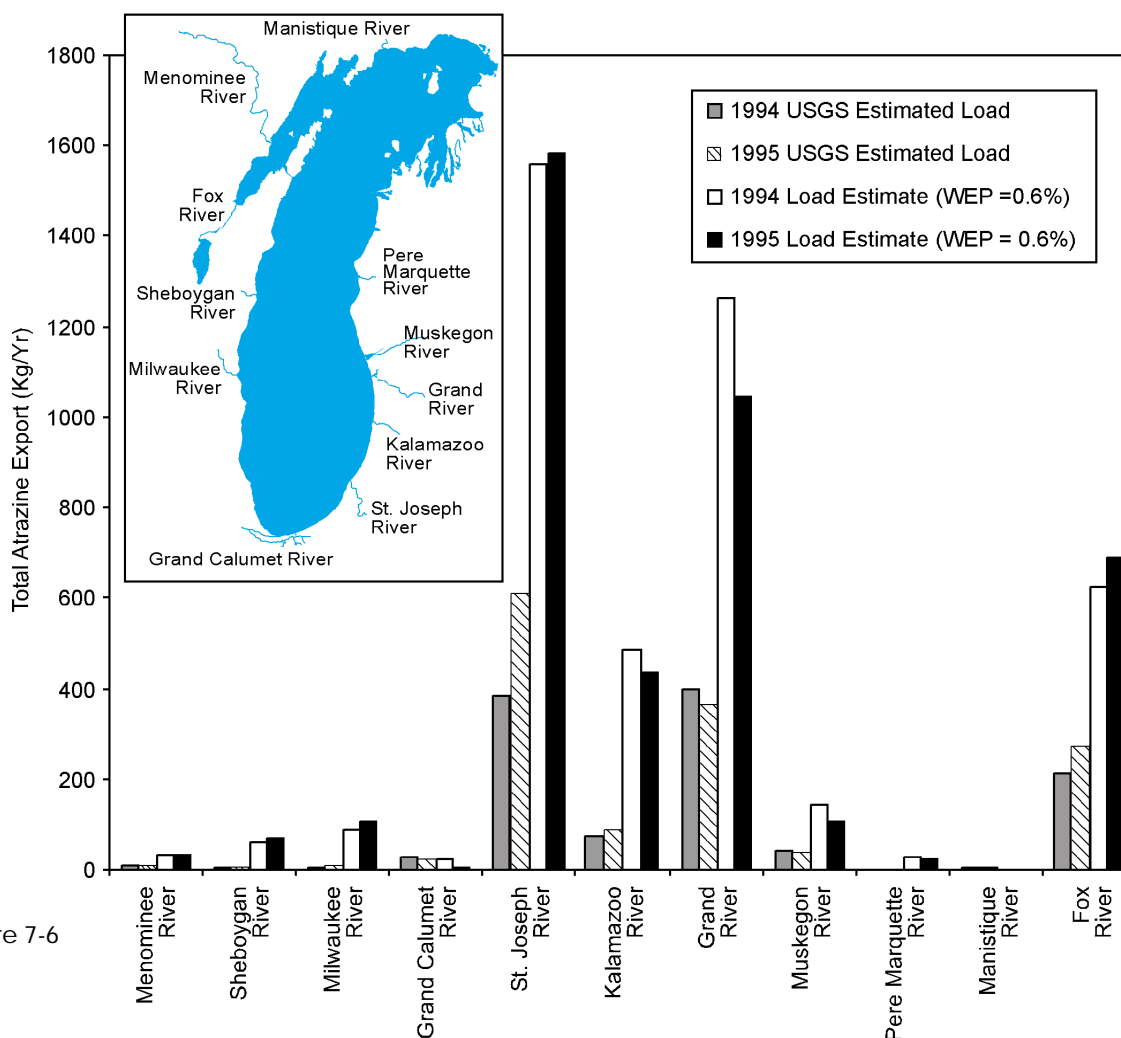


Figure 7-6

Cladophora blooms are again a common occurrence along the coast of Lake Michigan; however, the cause of these blooms is unknown.

U.S. EPA identifies polluted runoff as the most important remaining uncontrolled source of water pollution and provides for a coordinated effort to reduce polluted runoff from a variety of sources. Previous technology-based controls, such as secondary treatment of sewage, effluent limitation guidelines for industrial sources, point sources and management practices for some nonpoint sources, have dramatically reduced water pollution and laid the foundation for further progress. However, nonpoint source loads continue to turn rivers and streams into pollutant pathways to the lake. Total maximum daily load (TMDL) studies are needed for impaired tributaries

to identify the management measures needed to bring them back into compliance with water quality standards. Over the next several years, states will be developing many TMDLs for pollutants entering into water bodies from both point and nonpoint sources. TMDLs will provide data to help manage water quality on a watershed scale.

Major sources of nonpoint pollution include urban stormwater runoff, discharges from animal feeding operations, cropland runoff, and episodic combined sewer overflows. In addition, pollution can arrive via air from outside a watershed.

Urban nonpoint source stormwater is water from rain or snow that runs off city streets, parking lots, construction sites, and residential yards. It can

Rural Nonpoint Source Pollution Prevention

Federal legislation has established several programs to provide financial incentives or actual payments to agricultural landowners who choose to take land out of production. Using prescribed land cover for 10 to 15 years is a means of reducing agricultural runoff and the resultant erosion, sedimentation, water quality degradation, and habitat destruction in streams and lakes. Among these programs are the Conservation Reserve Program (CRP), the Conservation Reserve Enhancement Program (CREP), and the Continuous CRP (CCRP), which are managed through the Department of Agriculture's Natural Resource Conservation Service (www.nrcs.usda.gov). The U.S. Fish and Wildlife Service operates a private land management program to provide cost-sharing incentives to individual landowners for habitat improvement projects. There are similar programs at the state and local levels offering grants, tax offsets, or conservation easements. These programs are accomplished through local, voluntary partnerships between individuals and government and make use of financial incentives, which limits the number of participants because of resource constraints.

Approximately 1.4 million acres of buffers have been established in the Great Lakes region through continuous Conservation Reserve Program (CRP) and Conservation Enhancement Reserve Program (CREP) (over 54 percent of the nation's buffers are in the Midwest region). According to the Department of Agriculture's Natural Resource Conservation Service, the estimated benefits of these programs in relation to improved wildlife habitat and water quality rather than resource loss and degradation is 3 times more than the costs of the programs.

Catalog of Federal Funding Sources for Watershed Protection and Nonpoint Source Control

U.S. EPA has compiled a Catalog of Federal Funding Sources for watershed protection and nonpoint source control at <http://cfpub.epa.gov/fedfund/>. The web site is a searchable database of financial assistance sources (grants, loans, cost-sharing) available to fund a variety of watershed protection projects. Examples of funding sources include the U.S. EPA administered Section 319 Nonpoint Source grant program under the Clean Water Act and the Environmental Quality Incentives Program (EQIP) and the Conservation Reserve Easement Program (CREP) administered by the U.S. Department of Agriculture.

carry sediment, oil, grease toxicants, pesticides, pathogens, and other pollutants into nearby storm drains. Once this polluted runoff enters the storm sewer system, it is discharged, usually untreated, into local streams and waterways. It can contaminate drinking and recreational waters and remains a major source of beach closures.

In late 1999, EPA promulgated rules to reduce stormwater runoff from construction sites between 1 and 5 acres and municipal storm sewer systems in urbanized areas serving populations of less than 100,000 through the issuance of permits. These controls must be in place by 2003. This new stormwater rule builds on the existing program to control stormwater runoff from municipalities with populations greater than 100,000 and 11 industrial categories, including construction disturbing over 5 acres. Under the expanded program, sediment discharges from approximately 97.5 percent of the acreage under development across the country will be controlled through permits.

The Lake Michigan basin has a high concentration of agricultural enterprises where animals are kept and raised in confined environments. Polluted runoff from animal feeding operations is a leading source of water pollution in some watersheds. Potential impacts include the absence or low levels of dissolved oxygen in surface water, harmful algae blooms, fish kills, and contamination of drinking water from nitrates and pathogens and beach closures.

For the vast majority of animal feeding operations (AFO), voluntary efforts will be the principal approach to assist owners and operators in developing and implementing site-specific management plans. Impacts from higher risk, concentrated animal feeding operations (CAFO), such as sites with the equivalent of 1,000 beef cows, are addressed through National Pollutant Discharge Elimination System (NPDES) permits under the authority of the Clean Water Act. About 5 percent of all animal feeding operations are expected to need permits.

Control of Combined Sewer Overflows

Combined sewer overflows (CSO) continue to be a major source of pollution in the Lake Michigan basin. Combined sanitary and storm sewers were

commonly built throughout the Lake Michigan watershed as an economical means of managing urban wastewater. These systems are heavily concentrated in the northeast and Great Lakes regions. Under normal conditions, these combined systems are able to transport sanitary wastes and limited amounts of stormwater to a wastewater treatment plant for disposal. However, during heavy precipitation events, the combined sewer can become overloaded and discharge the untreated overflow containing sanitary and stormwater directly into surface waters. Because the overflows contain pathogens, toxic pollutants, solids, and debris, CSOs can create serious public health and environmental problems. CSOs are considered point sources under the Clean Water Act and are therefore subject to regulation.

On January 29, 2002, EPA delivered a Report to Congress on Implementation and Enforcement of the Combined Sewer Overflow Control Policy. This report provides an overview of the progress made in controlling CSOs across the United States. It also provides state-by-state summaries of CSO control programs. Additional information on the report and state CSO programs as well as the state-by-state summaries can be found at <http://cfpub.epa.gov/npdes/>.

Sediments: Both a Contaminant and a Pathway

Land disturbed by natural or man-made processes produce sediments that impair tributary mouths and spawning areas. Better understanding of sediment movement in the lake is the goal of the Episodic Events: Great Lakes Experiment (EEGLE) at www.glerl.noaa.gov/eeagle/.

Sedimentation in the tributary mouths and nearshore areas of Lake Michigan has been an ongoing problem. See the end of this chapter for a summary of sediment contamination and cleanups at the Lake Michigan AOCs. Substances found in Lake Michigan sediment reflect the land uses in near and upper portions of the watershed. Runoff from agricultural lands washes soil particles as silt that can smother aquatic habitat. The soil particles may also carry

Michigan Proposes New NPDES Permit for CAFOs

In March 2004, the Michigan Department of Environmental Quality released for public comment a new general National Pollutant Discharge Elimination System (NPDES) permit for new Large Concentrated Animal Feeding Operations (CAFOs), and announced public hearings on the permit. This new general permit has been developed to complement DEQ Director Steven E. Chester's February 27, 2004, Final Determination and Notice that directs certain new large CAFOs to get individual permits, and other new large CAFOs to obtain coverage under the general permit for new large CAFOs. In order to constitute a valid authorization, the general permit must be complemented by a certificate of coverage issued by the DEQ to an individual facility.

The general permit allows for the discharge of wastewater under very limited circumstances involving certain precipitation events and also lists prohibited discharges. Construction of manure and wastewater containment structures using a composite liner design is required, and the permit specifies the design factors. Also included is a requirement to have a minimum of six months of storage available at the beginning of winter. A Comprehensive Nutrient Management Plan (CNMP) must be developed and implemented. A CNMP describes the production practices, equipment, and structure(s) that the CAFO will implement to sustain livestock in a manner that is both environmentally and economically sound. The permit lists the minimum standards a CNMP must meet to prevent the discharge of pollutants to the waters of the state.

The general permit requires a field-by-field assessment to determine the suitability of each field for land application, and a field-specific spreading plan must be included in the annual report for the upcoming 12 months. Certain land application timing and methods are specified in the permit, including setbacks, restrictions on land applications when the land is flooded, saturated with water, frozen or snow covered, or if one-half inch or more of rain is predicted by the National Weather Service.

agricultural chemicals and nutrients into water bodies. Urban runoff also contributes sediments contaminated with pesticides, nutrients, oils, and other pollutants. Other contaminated substances discharged directly to the lake and its tributaries may bind preferentially with sediment particles. These substances accumulate or persist in the tributary mouths and nearshore areas because unlike smaller rivers that are constantly flushed with water, the lake is a sink. A drop of water

Pharmaceuticals, Hormones, and Other Organic Wastewater Contaminants in U.S. Streams, 1999-2000: A National Reconnaissance

To provide the first nationwide reconnaissance of the occurrence of pharmaceuticals, hormones, and other organic wastewater contaminants (OWCs) in water resources, the U.S. Geological Survey used five newly developed analytical methods to measure concentrations of 95 OWCs in water samples from a network of 139 streams across 30 states during 1999 and 2000.

OWCs were prevalent during this study, being found in 80% of the streams sampled. The compounds detected represent a wide range of residential, industrial, and agricultural origins and uses with 82 of the 95 OWCs being found during this study. The most frequently detected compounds were coprostanol (fecal steroid), cholesterol (plant and animal steroid), *N,N*-diethyltoluamide (insect repellent), caffeine (stimulant), triclosan (antimicrobial disinfectant), tri(2-chloroethyl)phosphate (fire retardant), and 4-nonylphenol (nonionic detergent metabolite).

Measured concentrations for this study were generally low and rarely exceeded drinking-water guidelines, drinking-water health advisories, or aquatic-life criteria. Many compounds, however, do not have such guidelines established. The detection of multiple OWCs was common for this study, with a median of seven and as many as 38 OWCs being found in a given water sample. Little is known about the potential interactive effects (such as synergistic or antagonistic toxicity) that may occur from complex mixtures of OWCs in the environment. In addition, results of this study demonstrate the importance of obtaining data on metabolites to fully understand not only the fate and transport of OWCs in the hydrologic system but also their ultimate overall effect on human health and the environment.

More information is available at:
http://toxics.usgs.gov/regional/emc_sourcewater.htm
 |

entering Lake Michigan will take an average of 100 years to either evaporate or be washed into Lake Huron. The retention time for a particle of sediment is even longer.

Remediating Lake Michigan's legacy of contaminated sediment continues to be a high priority, and some progress has been made toward remediating the most highly

contaminated sites on the lake in the past two years. As discussed under subgoal 1 "Can we all eat any fish?," two examples are moving forward on the Fox River in Wisconsin and Grand Calumet River in Indiana. From December 2002 to December 2003, USS removed 788,447 cubic yards of non-native sediments from the first 5 miles of the Grand Calumet River. The sediments are contaminated with PCBs, heavy metals, benzene, PAHs and cyanide. This project was conducted pursuant to a RCRA Order and Clean Water Act Decree at an approximate cost of \$51 million. An estimated 8 tons of PCBs and 2,400 tons of heavy metals were removed from the river.

Sediment dredging is also moving forward in other areas of Lake Michigan. The U.S. Army Corps of Engineers is moving forward with a Comprehensive Dredge Material Management Plan for Waukegan Harbor, Illinois. The plan calls for dredging 250,000 cubic yards of polluted material and disposing the material in a confined disposal facility.

Groundwater Pathways in Lake Michigan

Groundwater enters the Great Lakes as either direct or indirect discharge. Direct groundwater discharge is flow directly into a lake through the lake bottom. Indirect groundwater discharge is flow into a lake by way of a tributary stream.

Groundwater discharge is a significant determinant of the biologic viability of tributary streams and coastal wetlands. In undisturbed areas, groundwater discharge throughout the year provides a stable inflow of water with consistent dissolved oxygen concentration, temperature and water chemistry. Where land uses significantly reduce groundwater flow to a stream, reaches of the stream or wetlands may lose their biologic viability. Likewise, where land uses add contaminants to a stream or wetland, they also may become impaired.

Until recently, the impact of groundwater on surface water quality has largely been ignored. Nonetheless, groundwater can have a significant effect on the quality of water in stream tributaries to the Great Lakes and on coastal wetlands by

transporting natural and man-made pollutants to them. In agricultural and urban areas of the Great Lakes basin, contaminants on the land surface become dissolved in groundwater and eventually flows into streams, wetlands, and the Great Lakes. This widespread, diffuse flow of contaminants by way of groundwater is a type of nonpoint source contamination. Pesticides and nutrients, such as nitrate and phosphorus, are the principal nonpoint source form of pollution that reaches the Great Lakes by way of indirect groundwater discharge to tributary streams and coastal wetlands. The growing understanding of the importance of this pathway has led many States to begin setting ground water quality standards and regulating the substances that can be discharged to groundwater.

Areas of Concern: Legacy of Contamination and Community Stewardship

LaMP 2000 explained: In 1987 the Great Lakes Water Quality Agreement (GLWQA) between the US and Canada was expanded to address critical stressors affecting the basin's ecosystem. The intersections of major tributaries and the Lakes are areas where human activity by-products and collected river deposits concentrate. " The Parties recognize that there are areas in the boundary waters of the Great Lakes system where, due to

human activity, one or more of the General or specific Objectives of the Agreement are not being met. Pending virtual elimination of the persistent toxic substances in the Great Lakes system, the Parties, in cooperation with the State and Provincial Governments and the Commission, shall identify and work toward restoring and protecting beneficial uses in Areas of Concern or in open waters." (GLWQA)

For each AOC a stakeholder group was convened to work with federal and state agencies to develop remedial action plans that defined the problem and suggested remedial actions. This program has been very successful in capturing the energy and creativity of the communities. Unfortunately, agency funding and resources have been uneven and have never approached the scale needed for remediation of large-scale legacy sites. Federal authorities like Superfund, Resource Conservation and Recovery Act Corrective Action Program and the Clean Water Act have provided EPA the tools to address some of the large-scale actions needed. The U.S. Army Corps of Engineers has been given specific program authority for AOCs.

Federal and State agencies and the AOC communities want to move ahead, remediate and restore impairments and delist their AOC. Matching authorities to specific impairment sources and the recovery time needed for the

Milwaukee Metropolitan Sewerage District Joins with Dental Associations to Reduce Mercury in Wastewater System

The Milwaukee Metropolitan Sewerage District (MMSD) approved a first of its kind program in Wisconsin that, through the help of dentists, will be a significant tool in preventing mercury pollution from getting into Lake Michigan.

MMSD's new program will require approximately 500 dentist offices in the District's service area to install amalgam separators, devices that capture amalgam so that it can be recycled or disposed of properly. It is anticipated that this program will prevent 95 percent or more of the amalgam from dentist offices from getting into Lake Michigan. Dental offices are the largest source of mercury discharges to wastewater treatment plants, which are not designed to remove mercury from sewage. Used for fillings, dental amalgam is 50 percent mercury. When dental work occurs, vacuum systems remove waste amalgam from the mouth and deliver it into the sewer system. Amalgam separators are commercially available and range in price from several hundred to several thousand dollars for purchase. They can also be leased. Dentist offices will have until February 2008 to install the devices.

Revisions to MMSD's policy were developed through a partnership between MMSD, the Wisconsin and Milwaukee area dental associations and the Wisconsin Department of Natural Resources.

remediation actions to "take" in the environment are lengthy procedures. A number of new tools are now available:

- Delisting Principles and Guidelines- adopted by the U.S. Policy Committee in December 2001
- Workshops- Target setting and Delisting are the topics of a series of workshops sponsored by EPA's Great Lakes National Program Office and the Great Lakes Commission
- Area of Recovery terminology is being used to bridge the gap from remediation until impairments improve Lake Michigan
- Watershed Academy established in 2003 to promote watershed planning to address non-point-source pollution source of impairments
- Lake Michigan Watershed Academy providing framework for stewardship activities post AOC delisting- many AOC groups have evolved into watershed groups
- The Legacy Act- providing funding and new authorities for putting remediation partnerships together

Great Lakes Legacy Act

To address the problem of contaminated sediment in the Great Lakes, the Great Lakes Legacy Act of 2002 (the Legacy Act) was passed by Congress and signed into law by the President on November 27, 2002. The Act authorizes \$270 million in funding over five years beginning in fiscal year 2004, and includes specific funding designated for public outreach and research components. President Bush's 2005 budget proposal will include an unprecedented \$45 million for the cleanup of contaminated sediments in the Great Lakes system. The \$45 million will be used to start or further the cleanup of four to six of the areas of concern. The request is a \$35 million increase over 2004 Legacy Act funding.

Contaminated sediments are a significant problem in the Great Lakes basin. Although discharges of toxic substances to the Great Lakes have been reduced in the last 20 years, persistent high concentrations of contaminants in the

bottom sediments of rivers and harbors have raised considerable concern about potential risk to aquatic organisms, wildlife, and humans. As a result, advisories against fish consumption are in place in most locations around the Great Lakes. The problem harbor and tributary areas in the Great Lakes basin have been identified and labeled as "Areas of Concern" (AOCs), with 31 of these AOCs located on the U.S. side of the Great Lakes.

Under the Act, priority is given to the following projects:

- Remedial action for contaminated sediment;
- Projects that have been identified in a Remedial Action Plan;
- Projects that are ready to be implemented;
- Projects that will use an innovative approach, technology, or technique that may provide greater environmental benefits, or equivalent environmental benefits at a reduced cost; or
- Projects that include remediation to be commenced not later than one year after the date of receipt of funds.

Projects must lie within a U.S. Area of Concern and must include monitoring and evaluation of contaminated sediment, implement a plan to remediate contaminate sediments, or prevent further or renewed sediment contamination. All remediation projects require a 35% non-federal match, and must not suffer significant, further or renewed contamination. A site assessment, remedial alternatives evaluation, short-term/long-term effects analysis, and remedial design work must be completed or being addressed. Non-Remediation projects must have a 35% non-federal match, and must meet the Act's priorities as outlined above. Research and development projects must conduct research on the development and use of innovative approaches, technologies, and techniques for the remediation of contaminated sediments at U.S. AOCs. Public information projects must provide funding for public outreach and information at U.S. AOCs regarding remediation. The latter two aspects of the Act have not been funded. More information is available at www.epa.gov/glnpo/legacy.

Next Steps

- A mercury source reduction and sediment remediation strategy will be finalized.
- Contaminated sediment sites will be reviewed and their status will be updated for Legacy Act funding or delisting opportunities.
- Investigate nutrient contributions from the agricultural sector and non point sources during wet weather. Determine if nutrient levels are linked to *Cladophora* blooms.
- Hold meetings to discuss Lake Michigan Mass Balance models.
- Develop Impaired Waters Strategy through basinwide meeting.

Long-Term Objectives

- By 2004 and 2005, develop coordinated monitoring to provide a 10-year trend for the lake
- By 2010, remediation of 50 percent of AOC sites
- By 2020, remediation of 70 percent of AOC sites
- By 2025, remediation of 100 percent of AOC sites

Areas of Concern Overview

There is an increasingly strong focus on remediating the problems of areas of concern (AOCs). The ultimate goal is to ensure the effective clean-up of these contaminated areas and protect them by utilizing watershed stewardship activities as a means of ensuring their on-going protection.

The following matrix provides summary information for the Lake Michigan AOCs. It provides information regarding:

- AOC Name and Beneficial Use Impairments (BUIs)
- Primary Contaminants
- Geographic Area
- Stressors
- Programs
- Clean-Up Actions
- Key Activities Needed
- Challenges
- Next Steps

The Great Lakes Water Quality Agreement calls for Remedial Action Plans (RAPs) to restore and protect 14 beneficial uses in Areas of Concern. An impaired beneficial use means a change in the chemical, physical or biological integrity of the Great Lakes system sufficient to cause any of the impairments listed below (BUIs are listed in the AOC name column using the following numeration).

- I. **Restrictions on fish and wildlife consumption** - When contaminant levels in fish or wildlife populations exceed current standards, objectives or guidelines, or public health advisories are in effect for human consumption of fish and wildlife.
- II. **Tainting of fish and wildlife flavor** - When ambient water quality standards, objectives, or guidelines for the anthropogenic substance(s) known to cause tainting are being exceeded or survey results have identified tainting of fish and wildlife flavor.
- III. **Degraded fish and wildlife populations** - When fish or wildlife management programs have identified degraded fish or wildlife populations. In addition, this use will be considered impaired when relevant, field-validated, fish and wildlife bioassays with appropriate quality assurance/quality controls confirm significant toxicity from water column or sediment contaminants.
- IV. **Fish tumors or other deformities** - When the incidence rates of fish tumors or other deformities exceed rates at unimpacted control sites or when survey data confirm the presence of neoplastic or preneoplastic liver tumors in bullheads or suckers.
- V. **Bird or animal deformities or reproductive problems** - When wildlife survey data confirm the presence of deformities (e.g. cross-bill syndrome) or other reproductive problems (e.g. egg-shell thinning) in sentinel wildlife species.
- VI. **Degradation of benthos** - When the benthic macroinvertebrate community structure significantly diverges from unimpacted control sites of comparable physical and chemical characteristics. In addition, this use will be considered impaired when toxicity (as defined by relevant, field-validated bioassays with appropriate quality assurance/quality controls) of sediment-associated contaminants at a site is significantly higher

than controls.

VII. Restrictions on dredging activities - When contaminants in sediments exceed standards, criteria, or guidelines such that there are restrictions on dredging or disposal activities.

VIII. Eutrophication or undesirable algae - When there are persistent water quality problems (e.g. dissolved oxygen depletion of bottom waters, nuisance algal blooms or accumulation, decreased water clarity, etc.) attributed to cultural eutrophication.

IX. Restrictions on drinking water consumption or taste and odor problems - When treated drinking water supplies are impacted to the extent that: 1) densities of disease-causing organisms or concentrations of hazardous or toxic chemicals or radioactive substances exceed human health standards, objectives or guidelines; 2) taste and odor problems are present; or 3) treatment needed to make raw water suitable for drinking is beyond the standard treatment used in comparable portions of the Great Lakes which are not degraded (i.e. settling, coagulation, disinfection).

X. Beach closings - When waters, which are commonly used for total-body contact or partial-body contact recreation, exceed standards, objectives, or guidelines for such use.

XI. Degradation of aesthetics - When any

substance in water produces a persistent objectionable deposit, unnatural color or turbidity, or unnatural odor (e.g. oil slick, surface scum).

XII. Added costs to agriculture and industry - When there are additional costs required to treat the water prior to use for agricultural purposes (i.e. including, but not limited to, livestock watering, irrigation and crop-spraying) or industrial purposes (i.e. intended for commercial or industrial applications and noncontact food processing).

XIII. Degradation of phytoplankton and zooplankton - When phytoplankton or zooplankton community structure significantly diverges from unimpacted control sites of comparable physical and chemical characteristics. In addition, this use will be considered impaired when relevant, field-validated, phytoplankton or zooplankton bioassays (e.g. Ceriodaphnia; algal fractionation bioassays) with appropriate quality assurance/quality controls confirm toxicity in ambient waters.

XIV. Loss of fish and wildlife habitat - When fish or wildlife management goals have not been met as a result of loss of fish or wildlife habitat due to a perturbation in the physical, chemical or biological integrity of the Boundary Waters, including wetlands.

Lake Michigan Areas of Concern

